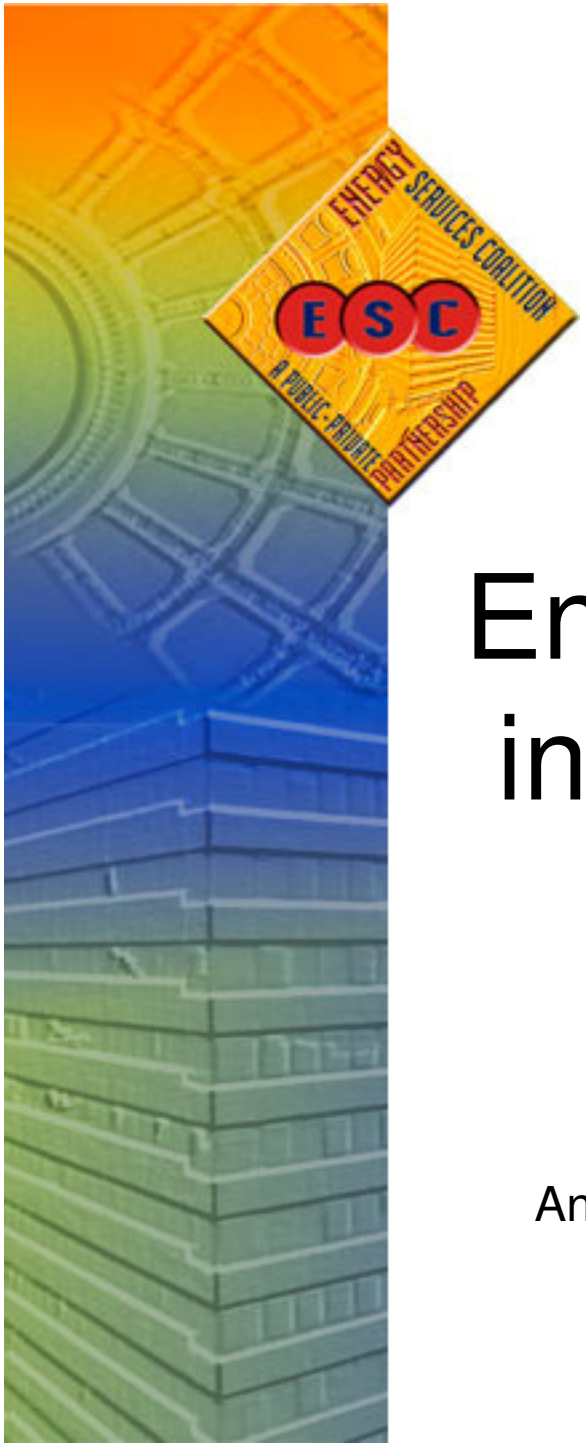


Energy Services Coalition
(ESC)

Energy Savings Strategies in Water and Wastewater

Ravi K. Bhaskar, Ph.D., Honeywell International
Angela Hedgecock, P.E., LEED AP, Siemens Industry

Electricity Use in the Municipal Water and Wastewater Treatment Sector is Significant

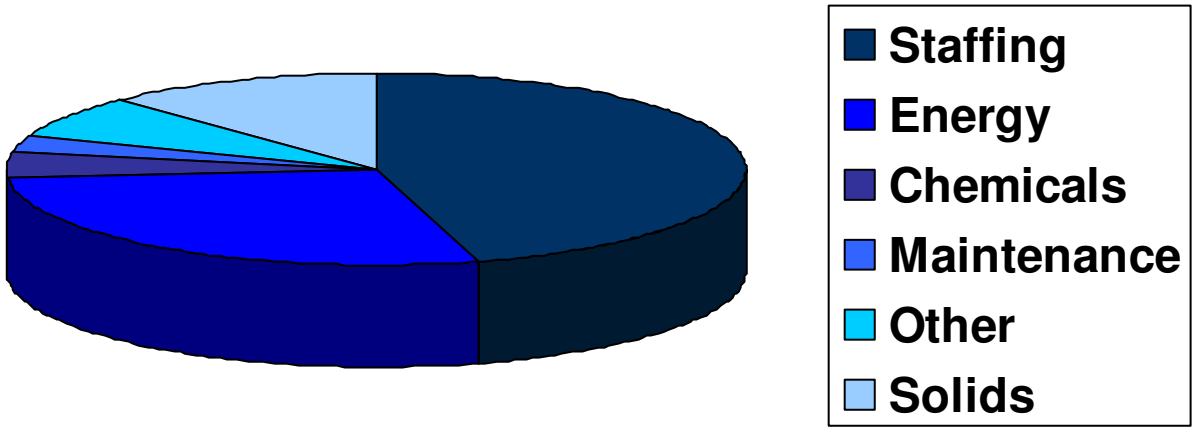
National numbers:

- Treatment and distribution of drinking water and collection and treatment of wastewater accounts for 3% of the U.S. electricity use (CEE, 2007)
- Sector consumes 35% of a municipality's energy budget (EFAB, 2001)
- Electricity is the 2nd largest operating cost at WWTPs, ~25 to 40% of the total operating budget (PGE, 2003)
- Electricity accounts for ~80% of all water processing and distribution costs at WTPs (EPRI, 2002)

…But Provides a Great Opportunity

- Preliminary estimates indicate an energy savings potential of 15 to 35% equating to 15 billion to over 30 billion kWh/year ($1.1B to $2.3B per year)
- Assuming an average simple payback of 10-years, that's $11B to $23B in capital projects that can be funded through electricity savings
- A typical 3 MGD activated sludge wastewater treatment plant can often reduce electricity costs by $30,000 per year or more with basic, proven upgrades

Energy Savings are Only One Part of the Solution

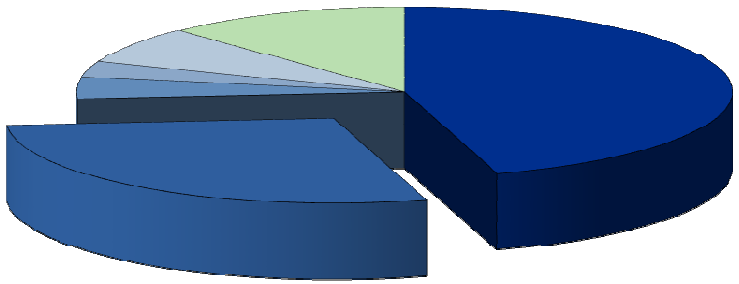


For most plants, opportunities for savings exist in every one of the cost categories shown.

Source: Jones, Ted. "Municipal Water/Wastewater Breakout Session." CEE. 18 January 2007.

Energy Savings are Readily Achievable

- Nearly one-third of a typical WW utility's annual expenses are energy costs
- Energy Efficiency Upgrade opportunities exist at all WWTPs and consistently provide savings of 10-15% or more and can exceed 50%
- Process Optimization can provide additional energy and non-energy savings



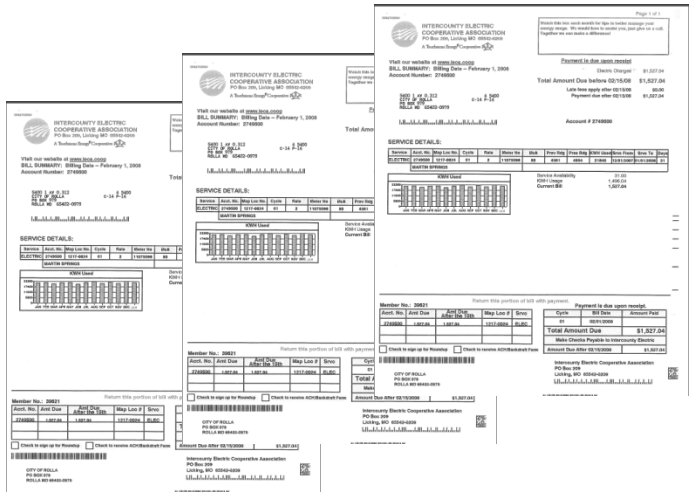
Source: Jones, Ted. "Municipal Water/Wastewater Breakout Session." CEE. 18 January 2007.

Driving Change – Today's Issues

- Regulations
  - Disinfection
  - Nutrient Removal (Phosphorus and Nitrogen)
  - Biosolids Management
  - Stormwater Bypass
  - Reuse Applications
- Aging Infrastructure
  - Population growth – increase in capacity
  - Resident complaints – odor control
  - Equipment aging – run to fail
- Energy and Operational Costs
  - Utility rates are on the rise
  - Hauling/Tipping fees going up
  - Safety Concerns

Energy & Operational Costs

- ALL Energy and Operational Costs should be reviewed frequently for your plant, including:
  - Electric Bills
  - Natural Gas Bills
  - Potable Water Bills
  - Transportation Invoices (sludge hauling/handling)
  - Permit Violation Fines
  - Equipment Maintenance Invoices



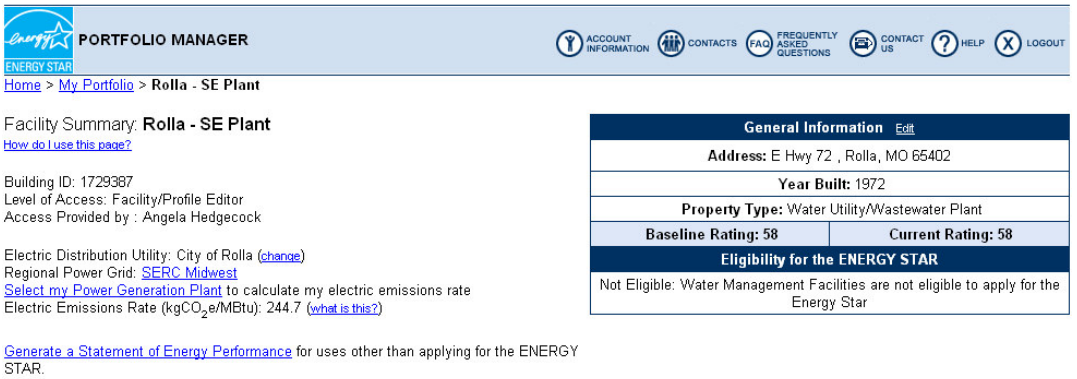
Your Utility Bill

- Bill Paid by the City
  - Operator may never see the bills
- Your Rate Structure
  - Base Charges (Minimum Monthly Bill)
  - Demand Charges (per kW)
  - Consumption Charges (per kWh)
  - Time-of-Use Charges (On and Off-Peak)
  - Power Factor Correction
  - Taxes and Credits
- Your Utility Company
  - Schedule a consultation to make sure you are on the correct rate structure
  - Rebates/Incentives may be available for plant improvements and interruptible service

Where do you Rank?

Tools Developed by the EPA

- Energy Star Portfolio Manager for Wastewater Treatment Facilities
  - Currently looks at total energy costs/MGD treated
  - More data required for smaller plants to be ranked
  - Does not include other operational expenses such as chemicals, maintenance
  - Great way to track the energy impact for changes made to your plant
- *Ensuring a Sustainable Future: An Energy Management Guidebook for Wastewater and Water Utilities*



PORTFOLIO MANAGER

ACCOUNT INFORMATION | CONTACTS | FREQUENTLY ASKED QUESTIONS | CONTACT US | HELP | LOGOUT

Home > My Portfolio > Rolla - SE Plant

Facility Summary: **Rolla - SE Plant**

How do I use this page?

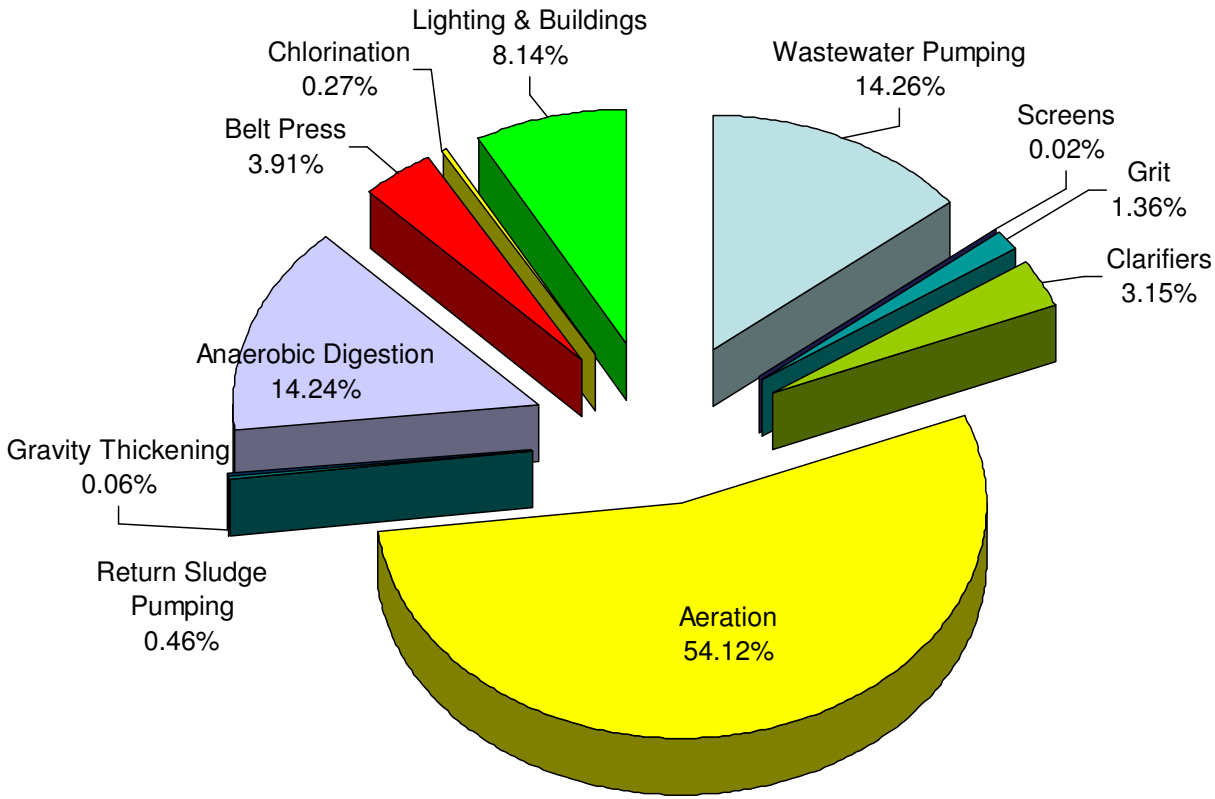
Building ID: 1729387
Level of Access: Facility/Profile Editor
Access Provided by : Angela Hedgecock

Electric Distribution Utility: City of Rolla (change)
Regional Power Grid: SERC Midwest
Select my Power Generation Plant to calculate my electric emissions rate
Electric Emissions Rate ($kgCO_2e/MBtu$): 244.7 (what is this?)

Generate a Statement of Energy Performance for uses other than applying for the ENERGY STAR.

General Information Edit	
Address: E Hwy 72 , Rolla, MO 65402	
Year Built: 1972	
Property Type: Water Utility/Wastewater Plant	
Baseline Rating: 58	**Current Rating: 58**
Eligibility for the ENERGY STAR	
Not Eligible: Water Management Facilities are not eligible to apply for the Energy Star	

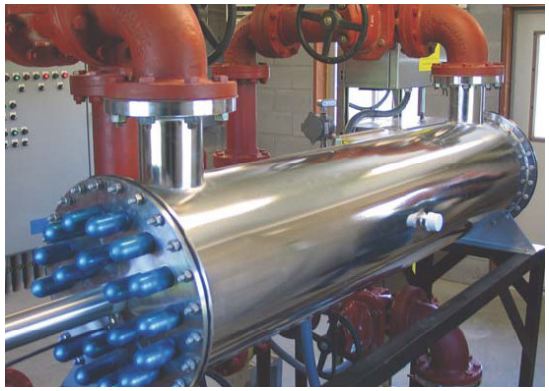
Facility Improvement Measures



Best Bang for the Buck

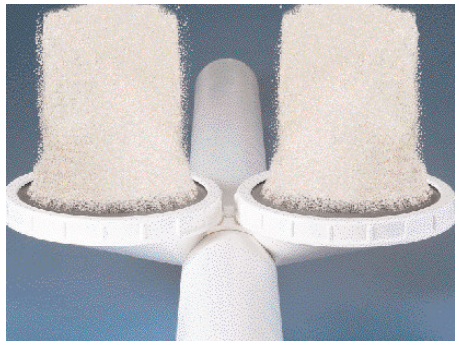
Life-Cycle Cost Analysis

- When determining if a Facility Improvement Measure is viable a Life-Cycle Cost Analysis should be performed
  - Example – Replacing Chlorine as your disinfectant with a UV system reduces your chemical costs, reduces plant safety hazard, and eliminates residuals in the effluent BUT you must consider the operations and maintenance costs of the UV lamps and the electricity costs for the system



Typical Facility Improvement Measures

- Power Factor Correction
- Lighting
- HVAC
- High Efficiency Pumps/Motors
  - Variable Speed Drives
  - Optimized Control Systems
- Aeration Systems
  - Coarse to Fine Bubble Diffusers
  - High Efficiency Blowers
  - Dissolved Oxygen Controls
  - Mixers Replacements
- Disinfection
  - Onsite Generation
  - Ultra-Violet
- Odor Control
  - Biofilters
  - Carbon Absorbers



Aeration

- 50 – 70% of the energy bill for a facility
- Over aeration
  - Maintaining dissolved oxygen concentration higher than what is justified by the loading (DO set point is too high)
  - DO is not controlled accurately
  - Fluctuating influent BOD loading may result in not enough aeration when the loading is high and over-aeration when the loading is low.
- Inefficient Aeration
  - Mechanical Floating Aerators 1 – 2 lb O_2 / hp-h
  - Coarse Bubble diffusion systems 3- 4 lb O_2 / hp-h
  - Fine Bubble diffusion systems 4 – 7 lb O_2 / hp-h
  - High Density Low Flux Aeration systems 7-11 lb O_2 / hp-h

Solutions

- Over Aeration
  - Calculate how much oxygen you need.
  - No less than 0.9 and no more than 1.8 lb Oxygen per pound of BOD removed
  - Dissolved Oxygen Controls
    - DO sensors
    - Spatial arrangement of DO sensors to match the mixing profiles within the reactor
    - Implementation of a rigorous maintenance and calibration program for DO sensors

- Inefficient Aeration
  - Select an appropriate diffuser configuration
  - Determine mixing requirements
  - Determine flow and pressure requirements for delivering the calculated amount of oxygen
  - Select an appropriately sized blower

Pumping Systems

- A single inefficient pump can waste $250,000 annually
- Pump Effectiveness measured in GPM/kW.
- Energy is typically wasted across control valves, overheated motors, and operating at a non-optimal point on the pump curve.
- Pumping systems can range from 40% to 95% in efficiency

Pumping Systems

- Pumps operate most efficiently at a specific combination of head and flow rate.
- VFDs most appropriate for varying flow and low head conditions.
- Correct pump sizing most appropriate for constant flow and high head conditions – impeller trim may be appropriate

Renewable Facility Improvement Measures

- Digester Gas Capture and Reuse
- FOG Receiving
- Landfill Gas to Energy
- Biomass
- Micro Hydro
- Wind
- Solar

Digester Gas

- Conservatively, 4.2 ft^3 of biogas is available per pound of BOD processed.
- A 20 mgd plant can generate 59 million ft^3 a year or 2.5 million kWh.
- FOG metering to the digester can increase biogas production by 50 – 80%
- Significant infrastructure needed for collection, metering, and blending of FOG

Questions ?